Disney

4B

SCIENCE in COMICS

Life in the Seas

THE ABC'S OF THE OCEAN

Disney COMICS

Disney **Science in Comics** is a series of comics titles designed to build a sound knowledge base for kids 8–12 years old, on science themes related to features and secrets of the world around us.

LIFE IN THE SEAS: *SAVING THE GREAT BARRIER REEF*

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RIDING THE CURRENT

The next morning, Nemo and his friends are ready to set off...

So, Dory... are you ready to go back to the Marine Life Institute in **Morro Bay**?

Oh, yeah! I'll never forget that place.

Where are Marlin and Nemo?

Nemo! Marlin! We're leaving without you!

No, wait for us! We're here!

Dad couldn't sleep. And didn't let me sleep. So I took him for a little morning swim.

Yes, so you need a rest now. We can stay home.

I know it's really important. But Nemo is a little fish. The journey is long... and dangerous... and...

No way! We're going together!

Yes! We have to save the ocean!

And we need you!

All right, guys! Can we go now?

Oh—okay... Let's go.

Now, who remembers the way to the Marine Life Institute?

Well, I got here from there, but... I don't know the route the other way around.

I do!

Really?

Of course!

And we can catch the current to get there!

Yeah, it will be faster!

That's a great idea! The **East Australian Current.**

EAC. Like a nickname! Hello, EAC!

NORTH

WEST

AUSTRALIA

EAST

SOUTH

EAC

The East Australian Current is the largest ocean current close to Australia.

"The East Australian Current flows along the east coast of Australia, south from the Great Barrier Reef."

"Each second, it transports 40 million cubic meters of water—as much water as in 16,000 of those big pools humans use for swimming!"

Great Barrier Reef

East Australian Current (EAC)

"It's 200 to 500 meters deep and travels at a speed of about 3 kilometers per hour."

Great, Mr. Ray! Now let's go find the EAC experts!

Crush and Squirt!

Of course! The **marine turtles!**

After a short swim...

Crush! Squirt! We need your help!

Nemo?!

Hey, dudes! What's up?

Can you help us catch the EAC to Morro Bay?

You betcha, dude! But the EAC doesn't go that far. At some point we gotta catch the **California Current**!

Oh, yeah! Now I remember... um... **dude**!

Whoa! We're gonna ride together!

Yep... we're gonna rock it!

So, pretty soon...

Kill the motor, dudes. You so totally rock!

Look at me! I'm riding the EAC!

Dory! Watch out!

WOOOSH!

Climb on, Dory, Come aboard!

Ah! Thanks, Hank!

Dad dude! What are those?

Look out, dudes!

SWISH

SWOOSH

BOING

Oh, no! It's plastic garbage!

Gasp! Nemo, stay behind me!

Hello! Are you going to Morro Bay, too?

Hmm... guess he was in a rush.

Dory, it wasn't a—

It must've been a jellyfish. They never say hi!

Tee-hee

Where does all this stuff come from?

From the humans on the coast, dude!

The climate has changed, and some currents in the Pacific Ocean have become **faster and stronger!**

No one knows the currents like you, Crush. I didn't even realize.

Thanks, Ray dude. The stronger currents hold a lot more trash and can carry it for a bunch of years, and then leave it on the **seabed!**

That's not good!

Those objects are **dangerous** for sea creatures, including turtles!

Exactly! Once I got tangled in a plastic ring. I got rid of it in the end, but it was tough!

Maybe we can pick up the trash and throw it away!

Yeah! Let's do it!

Hold on, there's too much plastic to clean up.

Tentacle dude is right! And we don't have trash cans in the ocean!

I'm sorry... we can't do it, Nemo.

And there's more to it. Did you know that some trash is **invisible**?

Invisible? Like a ghost fish?

Do you mean I'm surrounded by invisible trash right now?

Invisible plastic is called **microplastic**. It's not completely invisible, but very small and hard to see.

Oh, no! Can we do something about it?

Maybe we'll find an answer to this problem at the MLI.

They do really care about the ocean there.

Let's go then! Hurry up!

CONTINUES ON PAGE 77

THE IMPORTANCE OF CURRENTS

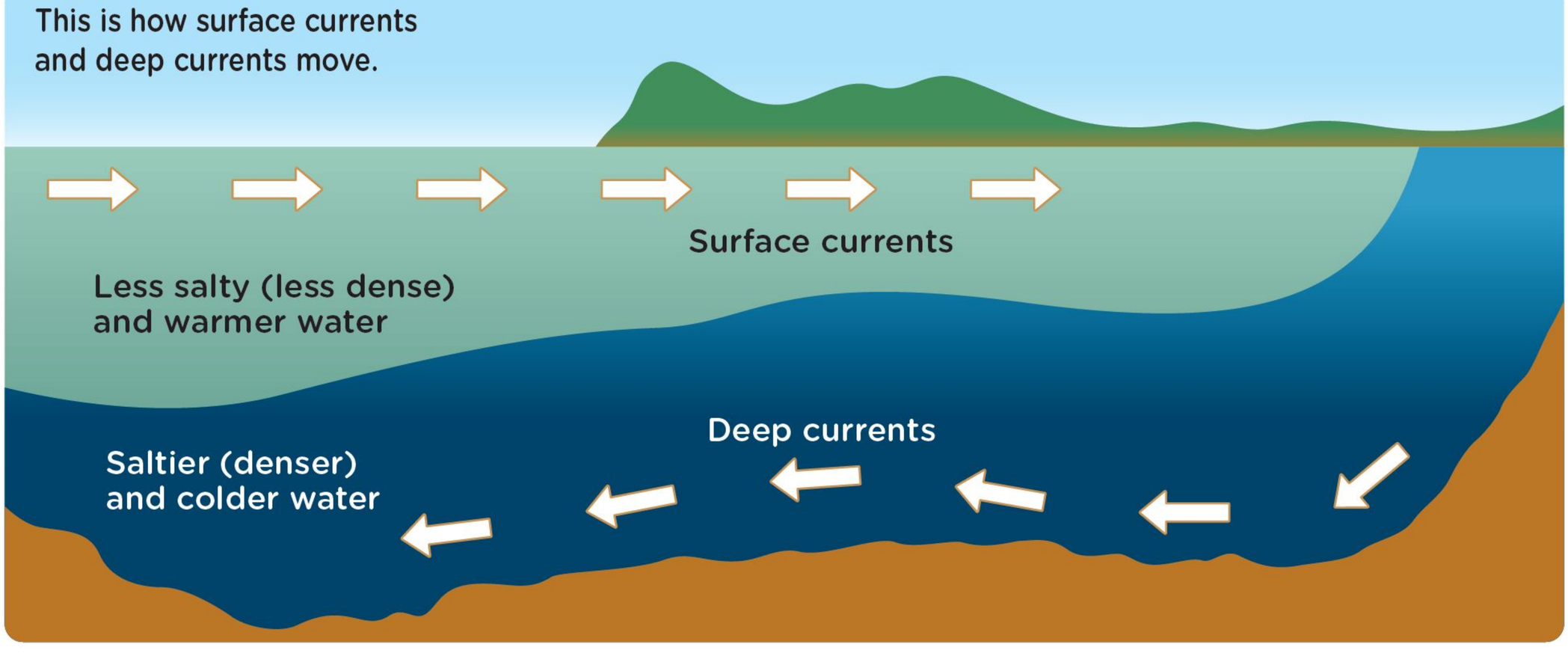
- Why does the water move?
- The currents in the Pacific . . .
- . . . and in the Atlantic!
- A broken mechanism?

Why does the water move?

TWO TYPES OF CURRENTS

As we've seen, ocean currents are very important since they regulate the climate of the whole planet. But they're not all the same. There are **surface currents** and **deep currents**. Surface currents move the upper part of the water, while deep currents flow in the depths, below the surface currents. The water moves not only because of the **wind** and the forces from **Earth's rotation** but also because of the **differences in temperature and salinity**—that is, the amount of salt in the water. In fact, the colder the water, the heavier it is, so it sinks toward the bottom of the sea, while warmer water remains closer to the surface. Saltier water is actually denser and heavier, so it sinks. These and other movements create the different surface and deep currents!

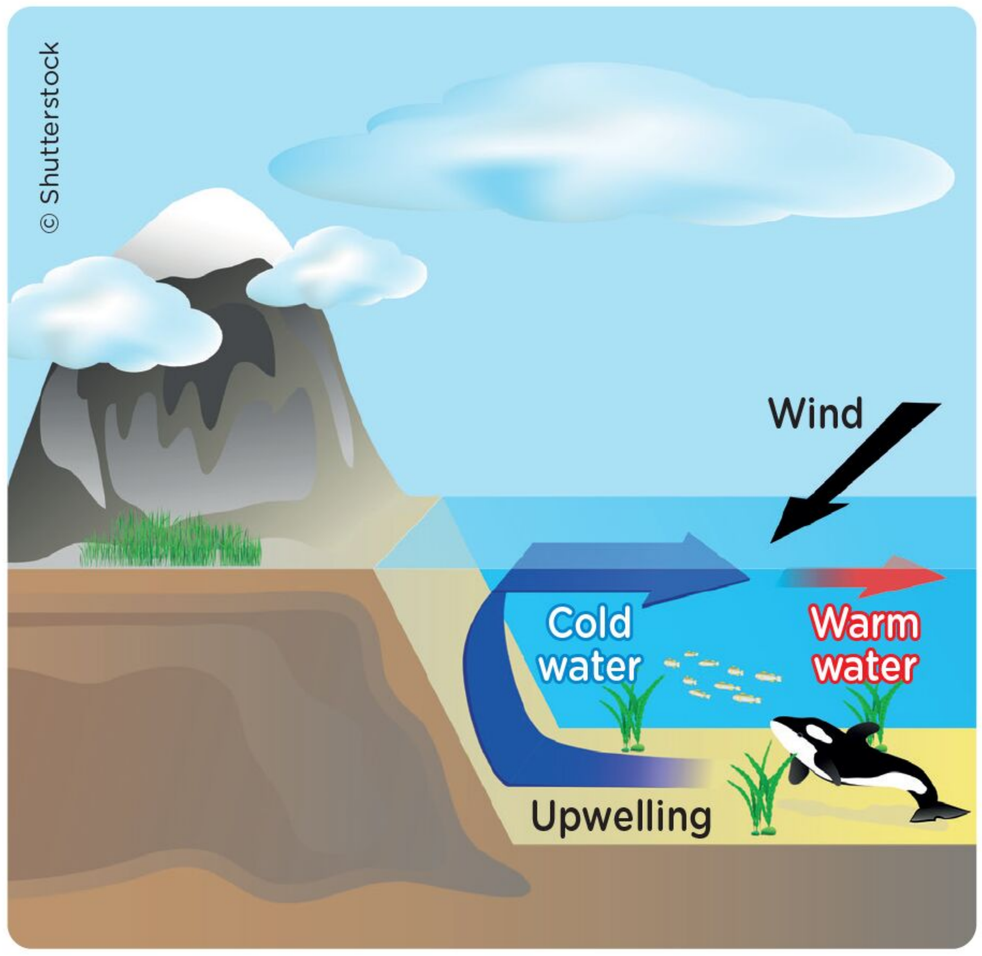
This is how surface currents and deep currents move.



The currents in the Pacific . . .

STIRRING THE WATERS

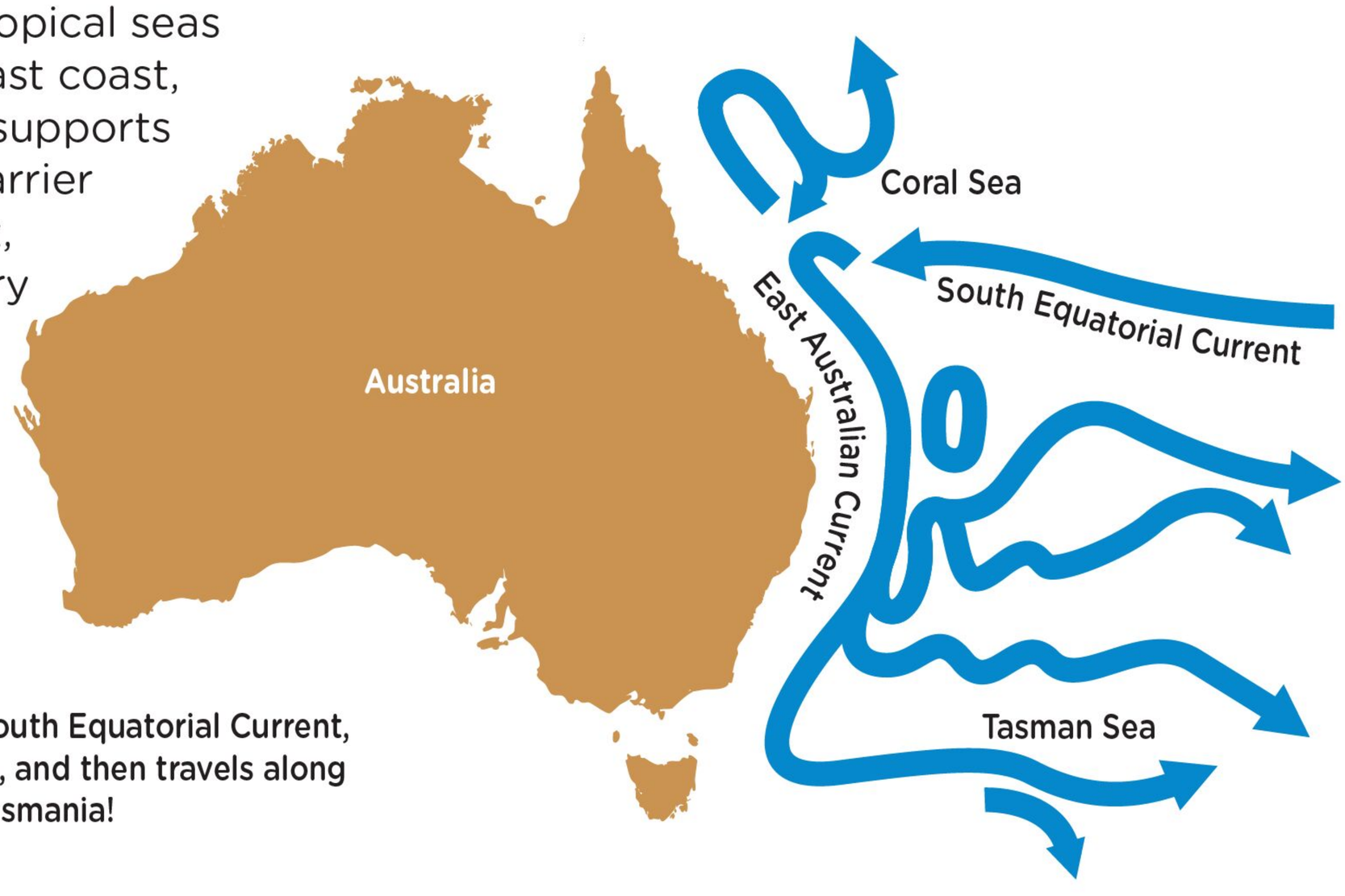
The waters in the ocean also move due to the wind. For example, the wind blowing along the coast moves the warmer surface water away from the land and consequently makes the colder water from the bottom of the ocean rise up into its place. This phenomenon of the deep water rising is called **upwelling**. It is important because the cold water is richer in nutrients, and as it rises, it supplies the surface water with food. For this reason many marine organisms, such as plankton, live there, as well as fish and marine mammals.



Upwelling is very extensive along the coasts of Peru; it also contributes to regulating the climate of the entire Pacific Ocean.

THE EAC AND THE IMPACT ON THE ECOSYSTEMS

There are many currents in the oceans, including a surface current that originates in the South Pacific Ocean: the **East Australian Current**, or EAC. The EAC carries warm, clear water from tropical seas along Australia's east coast, and in doing so, it supports life on the Great Barrier Reef. Corals, in fact, need warm and very clear water to survive. The EAC continues south, meeting the cold water of the Tasman Sea, warming it. But due to climate change, the EAC is getting faster and faster and going ever farther south! So the water of the Tasman Sea risks becoming too warm and endangering its ecosystems, which are suited to colder water.



The EAC starts from the South Equatorial Current, in the South Pacific Ocean, and then travels along Australia's east coast to Tasmania!

. . . and in the Atlantic!

THE GULF STREAM

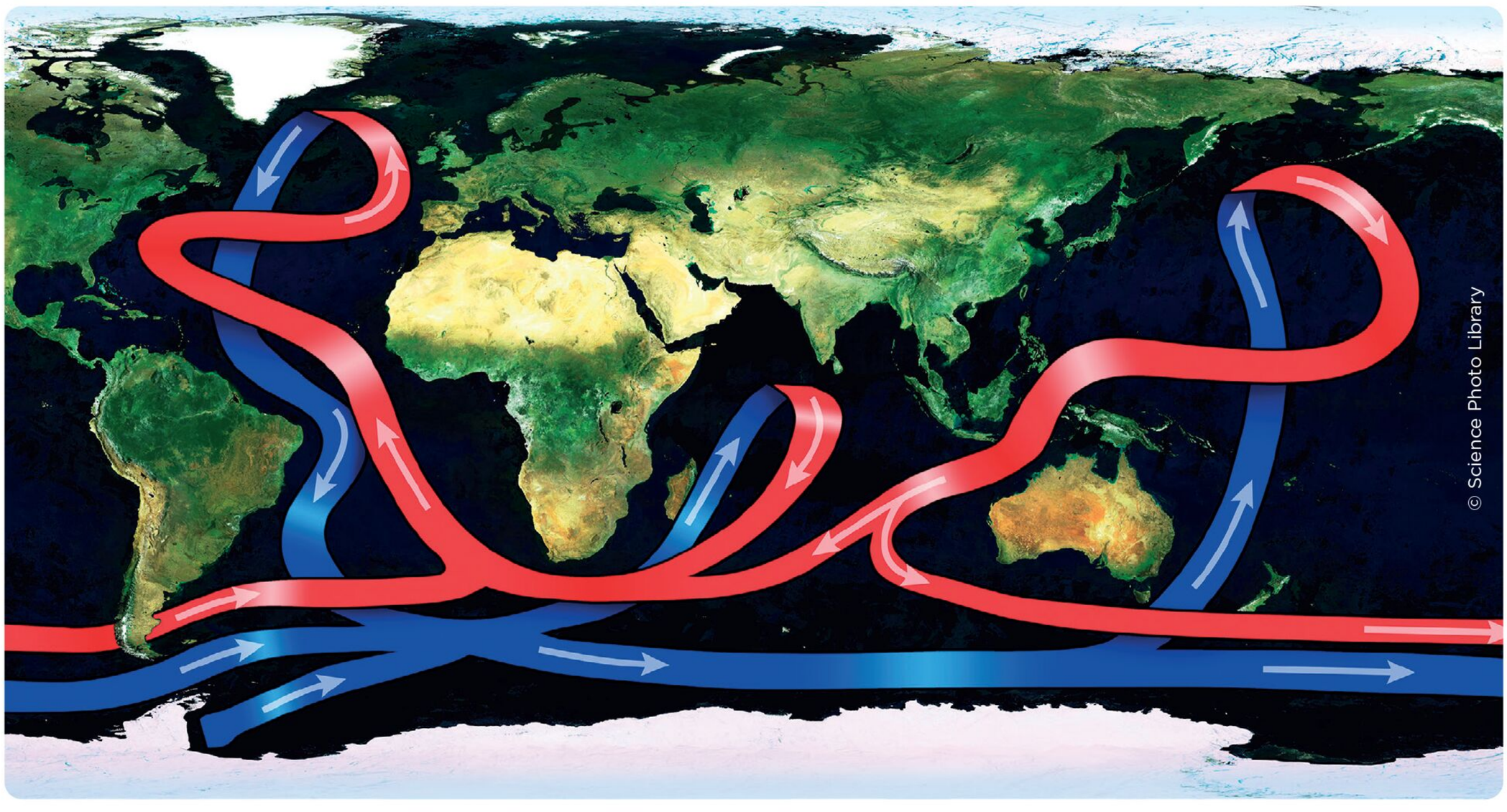
There is also an important surface current in the Atlantic Ocean: the **Gulf Stream**. It forms near Florida, where the warm waters of the Gulf of Mexico meet those of the North Atlantic Subtropical Gyre, then flows north. This is why the Gulf Stream carries a large amount of heat from the tropics to the north of the Atlantic, making the climate milder in European countries bordering the ocean—such as Spain, France, Great Britain, and even Iceland!

The Gulf Stream moves at an average speed of about 5 kilometers per hour!

A HUGE... CONVEYOR BELT

The Gulf Stream is part of a system called the **Atlantic Meridional Overturning Circulation** (AMOC). As it travels north, the warm water cools down. But cold water is heavier, so as it approaches the Arctic Circle, it sinks down and creates a deep current that moves south. Once in the tropics, the current warms up and the water returns to the surface. And the loop starts again!

The AMOC is part of the great conveyor belt, or the global circulation of ocean water. Warm currents—in red—and cold ones—in blue—are all connected to each other.



A broken mechanism?

SLOWER AND SLOWER LAPS

Due to climate change caused by humans, the temperature of the ocean is rising, so the water is less cold. What's more, the ice is melting; this dilutes the water and makes it less salty and less dense. So the currents **struggle to sink to the bottom and "turn over."** This is why the AMOC is constantly slowing down. Since currents are one of the principal regulators of the planet's climate, if they change, the climate is affected even more; for example, some humid regions will become even more rainy, and some dry areas will experience more and more drought.

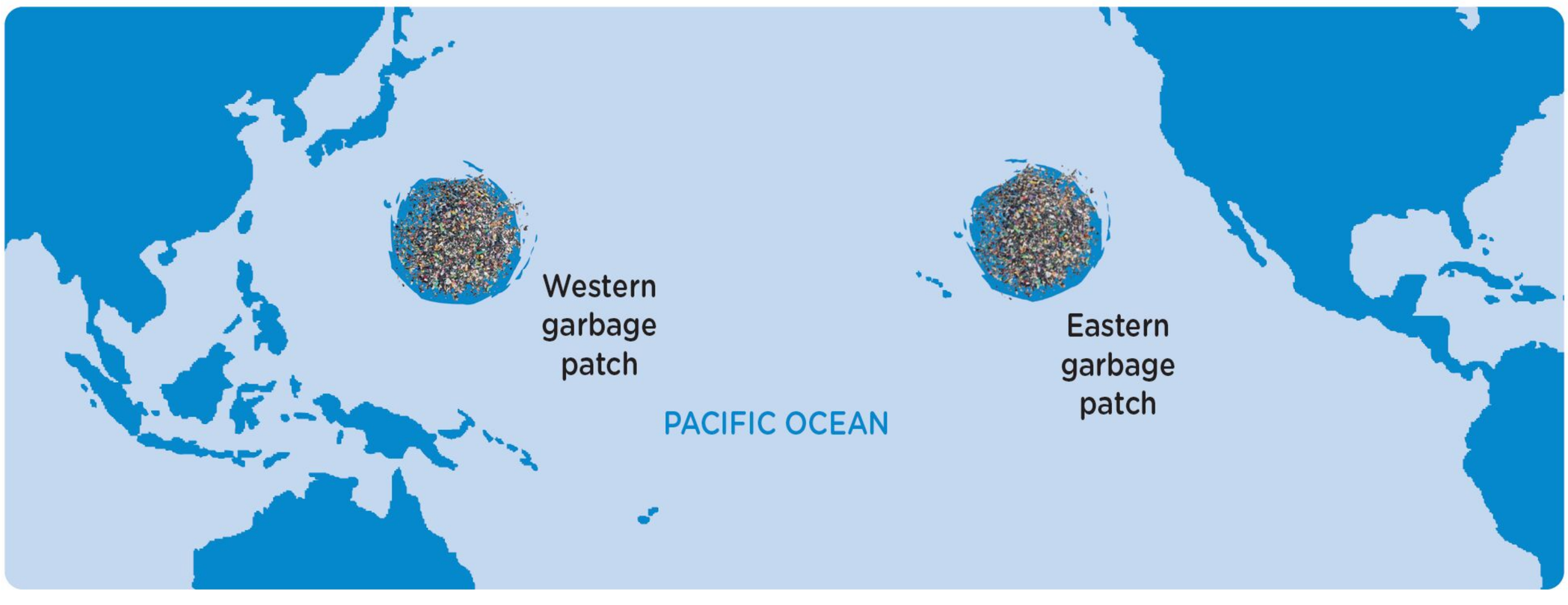
Violent weather such as hurricanes and floods is becoming increasingly frequent due to changes in currents, which affect the climate.

ISLANDS . . . OF PLASTIC!

Ocean currents don't carry just heat, nutrients, and marine organisms but everything that reaches the sea. Unfortunately, this includes . . . garbage. In recent years a huge amount of plastic has ended up in the ocean, getting trapped in the gyres of currents. Plastic doesn't disappear over time, because it can't be "digested" by any living organism: **it isn't biodegradable**.

As such accumulates in the ocean along with other garbage, creating patches that can be hundreds or thousands of kilometers across! What's more, plastic crumbles into very tiny fragments, called **microplastics**, which are difficult to remove. Many marine organisms eat them, even though they're dangerous to their health. In short, plastic puts entire ocean ecosystems at risk.

The ocean currents have created two huge patches of garbage and microplastics, one on the east side and one on the west side of the Pacific Ocean.



THE LOST SEAGRASS MEADOWS

After an exciting journey across some different currents...

Awesome, dudes! This is your exit!

I'm starting to get a bit California Current sick.

Don't forget to ask about the microplastic!

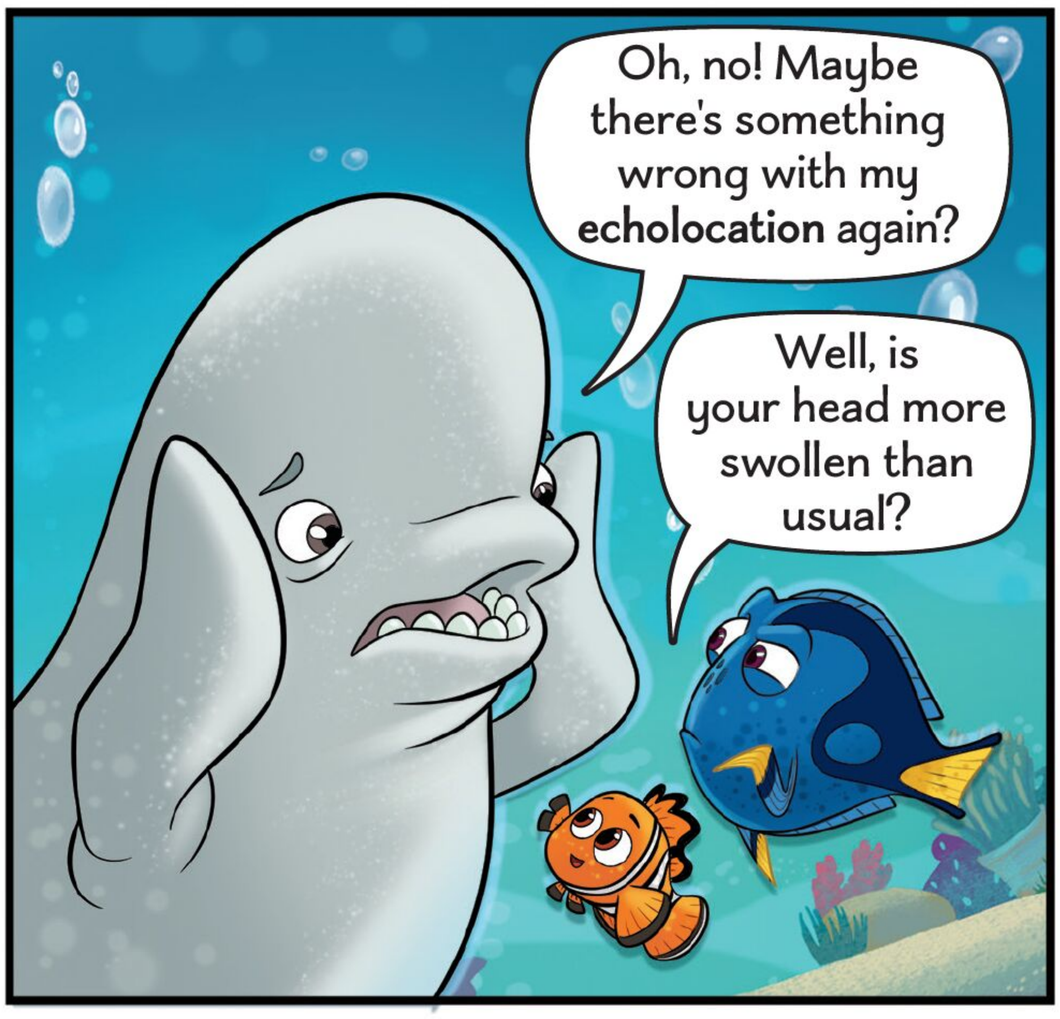
SWOOSH

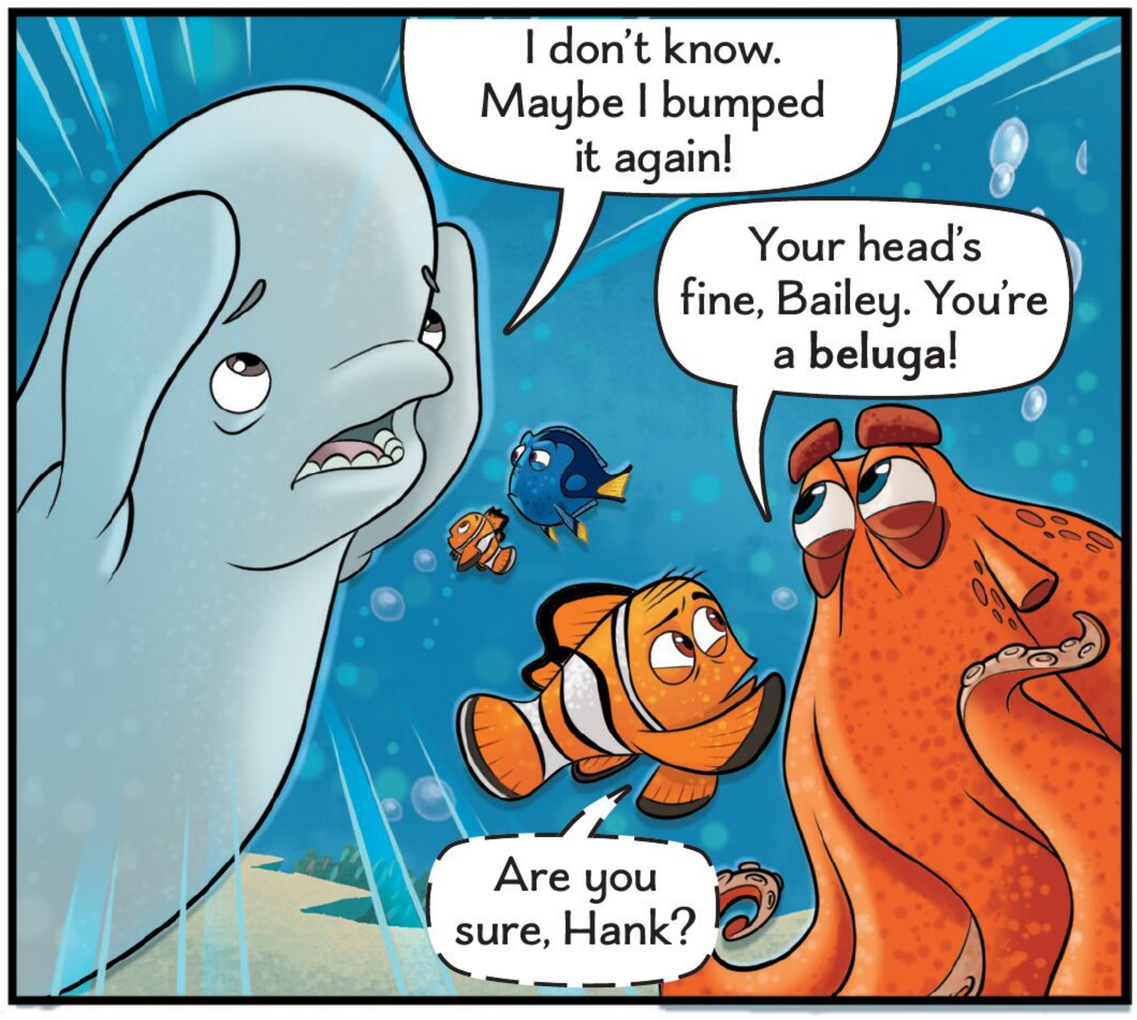
We'll ask!

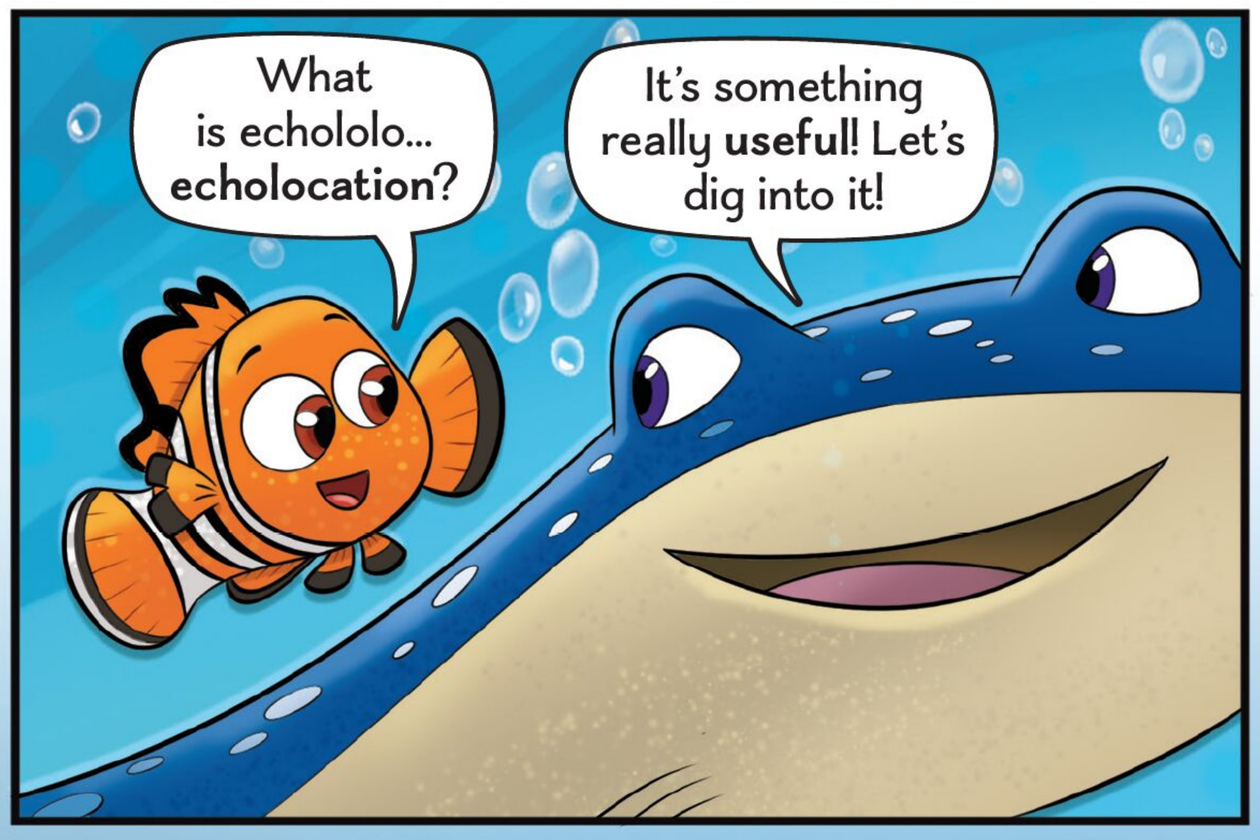
Byeeeee!

See ya!

But suddenly...
Hey!
Watch out!
Careful, Nemo!
Oh, I'm sorry. I--
Bailey?!
Guys! I'm so happy to see you. What are you doing here?!
We're going to the Marine Life Institute!
We need to find out more about some important problems.
I have a problem, too! I'm looking for a **seagrass meadow** where there used to be some nice snacks, but... I can't find it anymore!
That's strange.
Are you sure it was here?



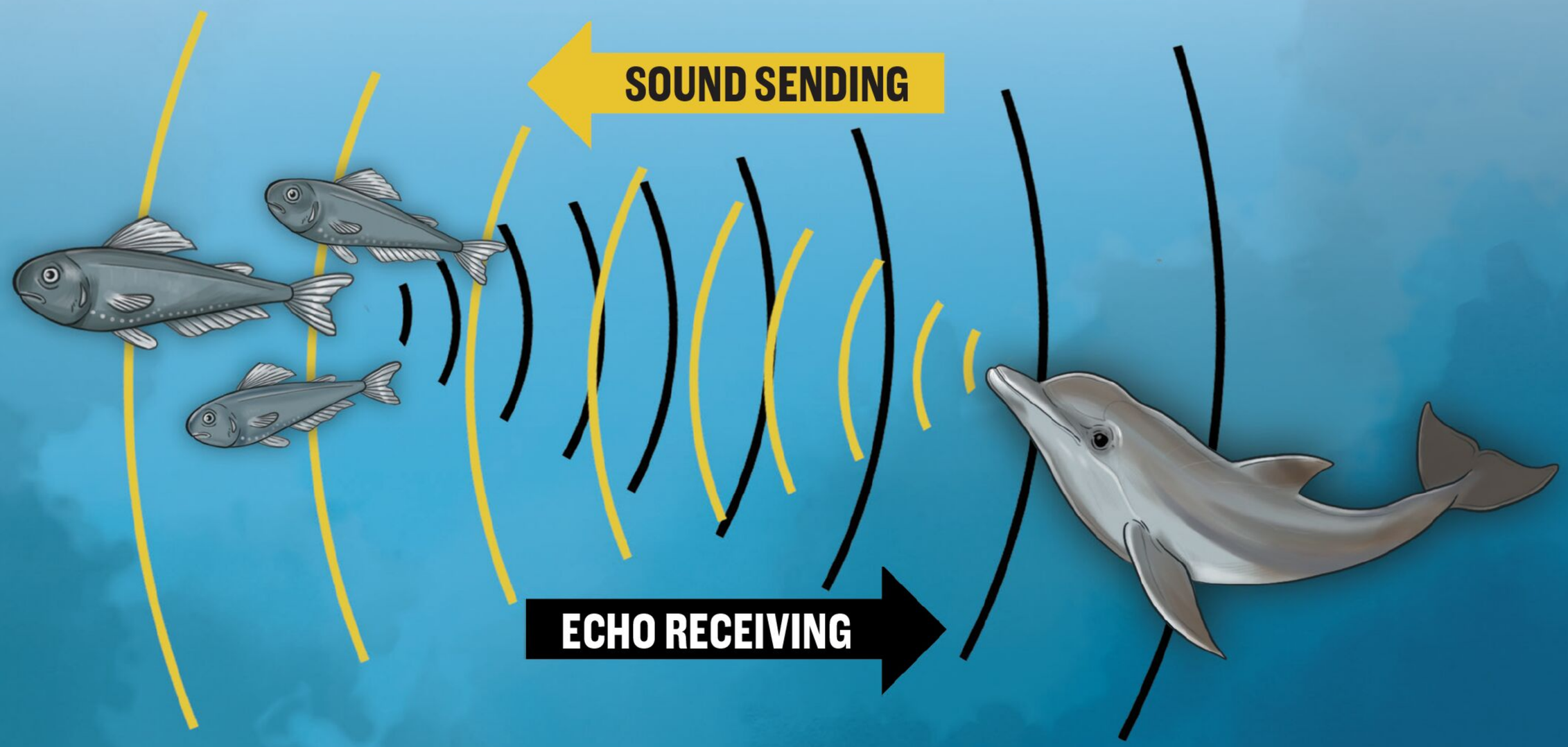




"Some **sea creatures**, like belugas and dolphins, send out **sounds** that travel through the water **like waves**."

"The **sound** waves **bounce off** fish, rocks, seaweed, and other obstacles and travel back to the creature. The reflected sound is called an **echo**."

"The sea creature can tell how **far away** the obstacle is based on how long the echo takes to return."



Whoa! I wish I had it, too.

Yeah. Echolocation is cool!

But mine isn't working anymore, because I can't find that seagrass meadow!

Here we go again.

Can you take us to the place where the meadow was supposed to be?

Sure! It's not far from here!

Let's go and see!

Dad, I wanna help Bailey, but we need to go to the MLI!

I know.

Don't worry, Nemo. We'll do both things.

Not far away ...

Here we are. But I'm not sure this is the right place.

Nah. This doesn't look like a seagrass meadow to me.

I only see sea urchins.

Don't touch them, Nemo! They might sting you!

Sea urchins don't sting!

Ouch!

Ahem...

Well, maybe they're just a little pointy.

Do you think the seagrass meadow was here, Mr. Ray?

I do!

Really? So my echolocation *does* work... I knew it was here!

But... where has the seagrass gone?

Looks like it disappeared because the water got too **warm**.

Oh, no! Like the seaweed forest.

Yes, Nemo.

"Sea urchins do really well in warm water and rapidly increase in numbers."

"But there's a big problem: the more of them there are, the more seagrass they eat."

"So the seagrass meadows disappear and get replaced by sea urchin barrens."

What does **barren** mean, Dad?

Well, it means... that nothing's there.

That's right. It's an area where seagrass doesn't grow anymore!

Oh, no! That's really bad!

Yeah, this is a big problem.

Guys... maybe I can come to the MLI with you. If my echolocation's fine I can take you there!

Yay! It's gonna be great!

Yes, but we must be quick. The ocean has lots of problems.

We have to do something about them!

What were the other problems again?

The coral is bleaching!

And the seagrass is gone.

And the currents are changing!

And don't forget about the shells getting more fragile.

Hey, you're right. We've gotta do something!

Yes, our home is in danger!

There's no time to lose. Let's go to the Marine Life Institute!

We'll look for some answers about sea urchin barrens, too.

Yeah, I don't want the other seagrass meadows to disappear!

Dad, do you think we can fix all these problems?

I don't know, Nemo, but if anyone can do it, you can. You may be a small fish, but I've seen you do some pretty big things.

Your dad's right, Nemo!

Thanks, Dad! Let's go find some answers!

CONTINUES ON PAGE 91

LIVING IN THE SEA

- Moving among the waters
- Navigating . . . with sounds
- Submerged meadows
- The deserts of the sea

Moving among the waters

MANY WAYS TO HUNT

Ocean animals travel for many reasons, especially to look for food. And each does so in its own way! For example, jellyfish move only up and down along the water column, and drift following the currents. Turtles, on the other hand, swim for thousands of kilometers, often searching precisely for . . . jellyfish! This is one of their favorite foods. So turtles often make use of the warm currents, which are rich in jellyfish.

Other animals, such as dolphins, hunt mainly in upwelling areas, which are very rich in fish.

To swim, jellyfish contract, creating movements in the water around them that cause them to travel up and down.

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Navigating . . . with sounds

ECHOLOCATION

Dolphins and other marine mammals, such as belugas and orcas, have a really special tool for hunting: **echolocation**! A special organ inside these animals' heads, the **melon**, produces **ultrasounds**—sounds too high-pitched for the human ear to hear—that spread like waves and can travel hundreds of meters. When they hit something, they "bounce" off, come back, and travel through the lower jaw before reaching the inner ear.

Thanks to these echoes, the animal that has emitted the ultrasound gets a very precise map of the surrounding environment. So it can understand the size, distance, and speed of what's in front of it (including the prey it wants to hunt).

Echolocation is useful for moving in the dark, or with little light, and not just in the ocean: bats use it, too!

THERE'S TOO MUCH NOISE!

Now there's a new threat to dolphins and other animals that use echolocation: **noise pollution**. Loud noises have actually increased in the ocean, because of humans and how they use the sea. For example, since 1950 the noise in the sea has doubled every ten years due to the increase in boats and shipping traffic. So some animals are no longer able to properly use echolocation: they struggle to navigate, escape from dangers, and find food. Many other marine species are also at risk, disturbed by too much noise. In short, noise pollution threatens the entire ocean!

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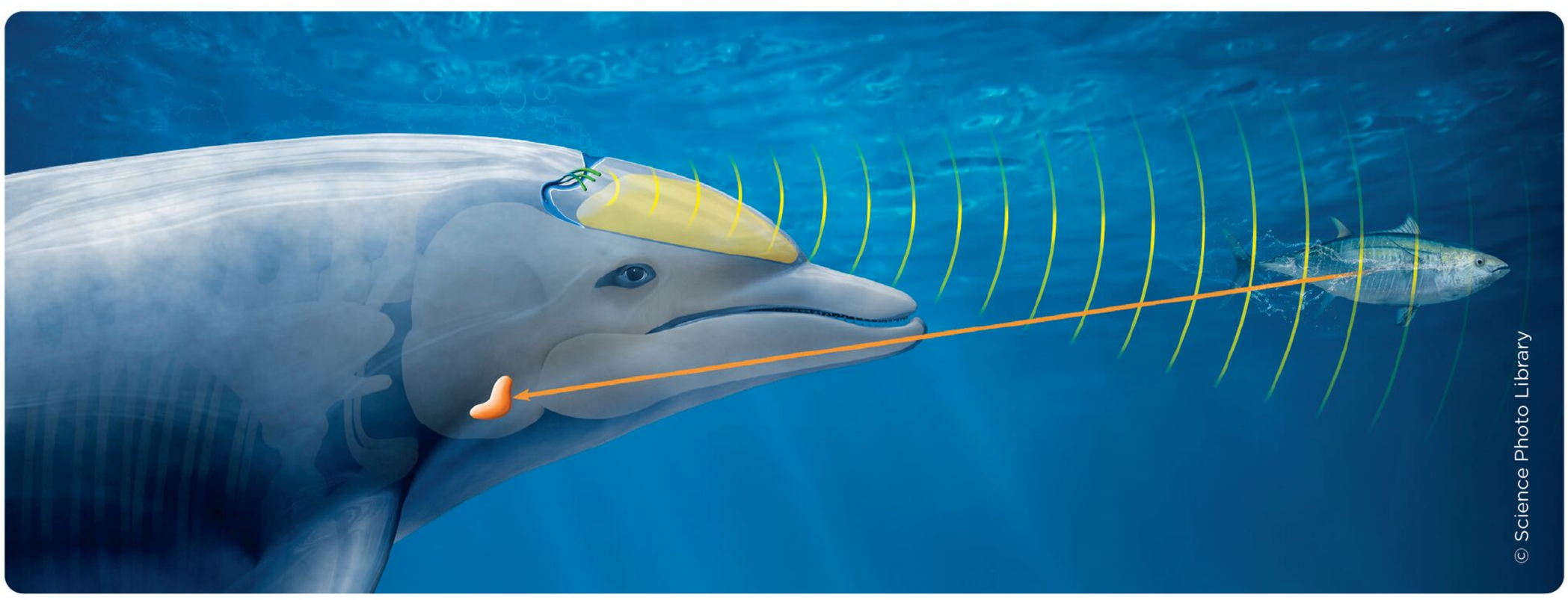
Sometimes, due to noise pollution in the sea, cetaceans like pilot whales get lost and end up beaching themselves on the coasts, putting their lives in danger.



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The melon is an organ made from adipose tissue, which is rich in fat; this is where the ultrasounds start. The echoes are then received by the inner ear (in orange).

Submerged meadows

PLANTS IN THE SEA

In an ecosystem, every animal or plant species is part of a food chain: each species feeds on others, which, in turn, eat other species. And plants are very important in the **food chain**, even in the ocean, since they feed many marine organisms. Under the surface of the sea, there are real **sea meadows** made up of plants with roots, stems, leaves, flowers, and fruits that have adapted to living underwater. The meadows are a habitat rich in biodiversity. Here, benthos and nekton organisms can easily find the food they need: the plants themselves, but also small crustaceans, mollusks, and urchins.

CAN YOU SEE ME?

Sea meadows are a food reserve, but also a refuge. Indeed, many animals use them . . . to hide! For example, seahorses can **camouflage** themselves in the meadows, by blending in with the plants, to escape from predators. Crustaceans, mollusks, and fish also live in the meadows when they're still small, taking shelter there. But predators also hide among the plants in order to ambush their prey.

The meadows offer a perfect habitat for nocturnal animals, which find shelter from daylight.

© Shutterstock

Seahorses' appearance and colors allow them to blend in well with the sea meadows. So predators struggle to find them!

The deserts of the sea

DANGEROUS CHANGES

In addition to providing food and shelter, sea meadows have other important tasks. In fact, thanks to photosynthesis, marine plants produce oxygen and absorb carbon dioxide from the sea. And they also protect the coasts because they form a barrier that slows down the waves, preventing **erosion of the coastal zone**—crumbling caused by the impact of the waves.

Unfortunately they are threatened by pollution, rising water temperatures, and human actions. For example, fishing in certain areas of the ocean has made sea urchin predators disappear. What's more, the warmer water allows the sea urchins to thrive, which has led to a rapid increase in their numbers. So they've started to consume more and more food, and their food is the meadows themselves! The sea urchins eat them so quickly that the meadows can't regrow. This is how deserts, called **barrens**, are created in the sea. Just like in the Tasman Sea, reached by the East Australian Current: its waters have become too warm and been invaded by sea urchins, which have destroyed the sea meadows.

The excessive population growth of sea urchins, destroying sea meadows, is an example of what happens when an ecosystem is altered.

MYSTERIOUS ROCKS

The group, led by Bailey, has almost reached Morro Bay...

Ummm...

What's wrong, Bailey?

Are we in a dangerous area?

No, this is a nice place!

I think my echolocation has stopped working.

What? Again?

Are you sure, Bailey?

I dunno... there used to be a group of rocks ahead of us, but the sound waves that bounced on it were... different!

Different? How?

I think that the underwater part of the rocks has gotten **bigger**!

Bigger? That's not possible...

Can you take us there, Bailey?

Yes, I think so.

Let's go and see!

Later...

Here it is! It was much smaller last time I was here.

I think I know what happened.

Really?

Yes, these rocks have been partially **submerged** by the water.

Submerged?!

It means covered by water! Are you sure it's not just **high tide**?

I don't know.

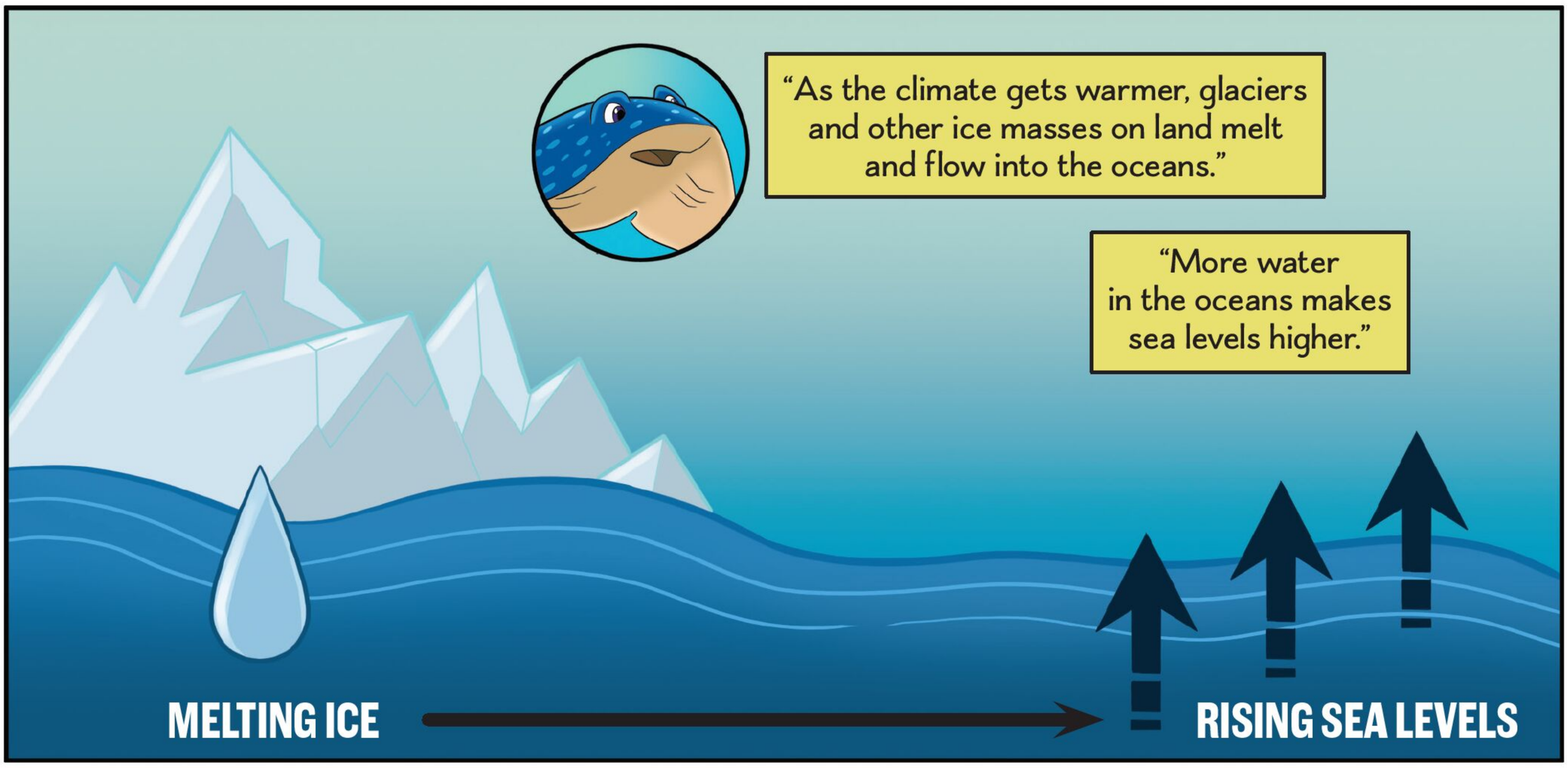
No, it's not because of the tides.

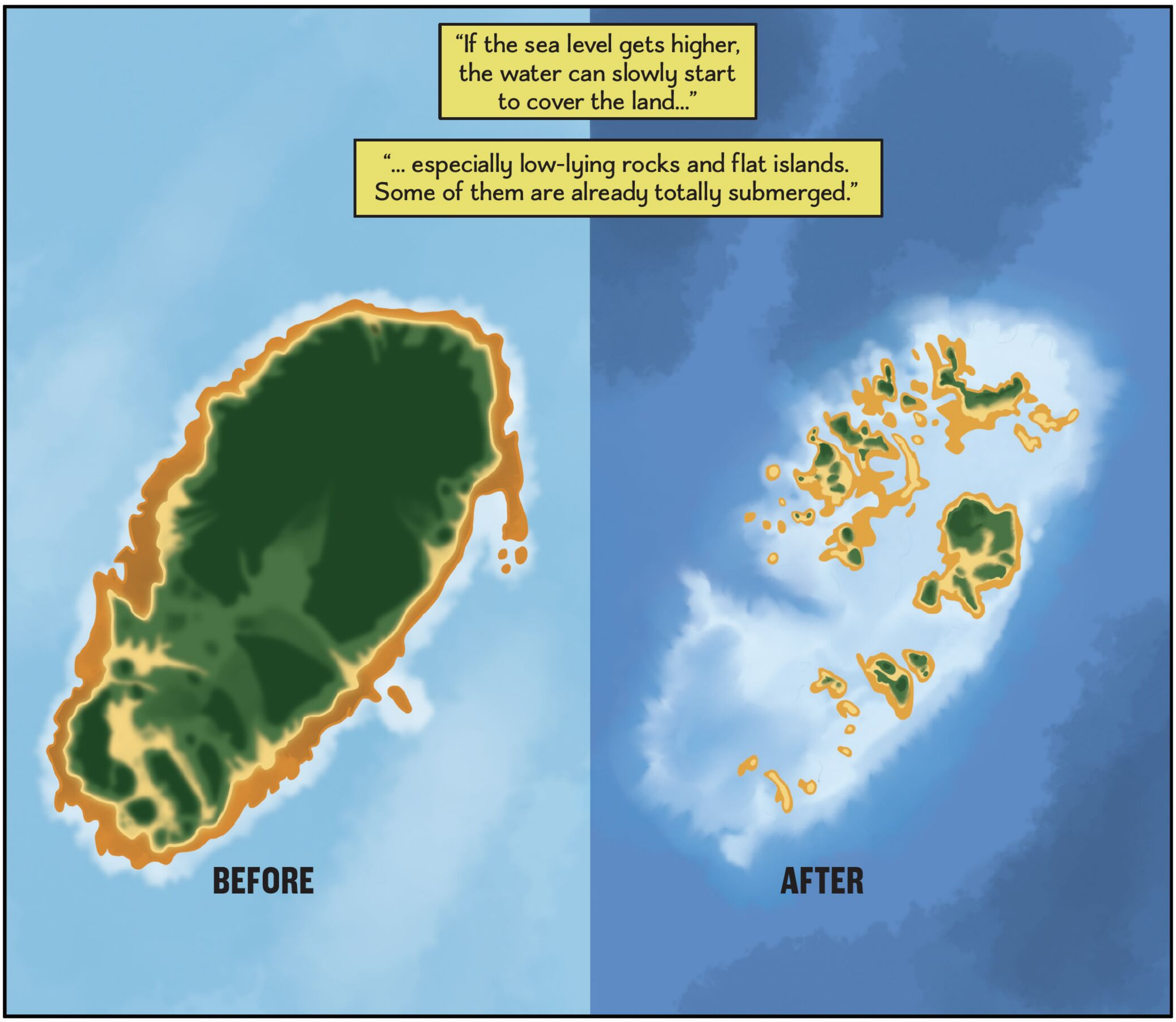
Sea levels are **rising**! This is due to **climate change**!

I overheard something like that at the Marine Life Institute. But they were talking about islands, not rocks.

Islands? Like tropical islands?

Exactly! Especially **flat** islands.


"As the climate gets warmer, glaciers and other ice masses on land melt and flow into the oceans."
"More water in the oceans makes sea levels higher."
MELTING ICE
RISING SEA LEVELS


"If the sea level gets higher, the water can slowly start to cover the land..."
"... especially low-lying rocks and flat islands. Some of them are already totally submerged."
BEFORE
AFTER

So... all the islands and rocks are gonna be underwater?

No! But some of them are in danger.

That's really bad!

Do you think we can fix this, Dad?

I don't think so.

But maybe we can find out more at the **Marine Life Institute**.

You're right. Let's go!

What's that **huge shadow**? Nemo, stay behind me!

It's a big container ship!

I hope the humans don't see us!

Impossible! We look like seaweeds.

Um... Dory, you're still blue.

Oops, I forgot I can't change color like you can.

Hey! What's happening to the ship?

WHOOOSH

Who is that crab?

WHOOSH

Uh, maybe one of the ship's passengers?

Kind of, Dory. It's a green shore crab, and it's an... **alien species**.

Alien?

What do you mean?

It means that it comes from another sea.

So... they're not from around here!

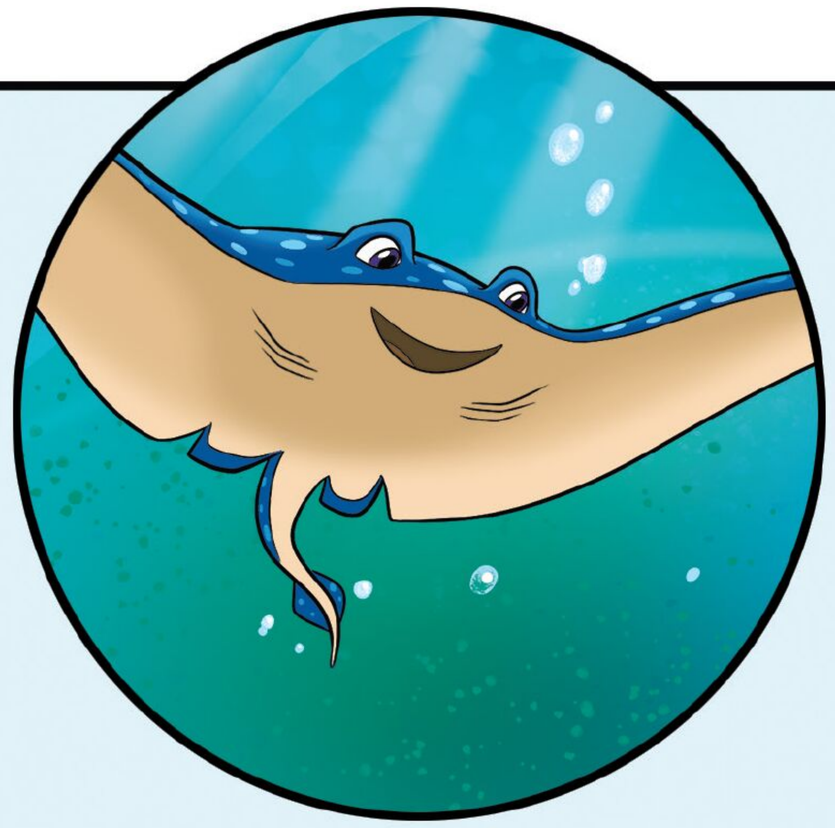
Yeah, I remember that some of them were treated at the MLI.

Why did it climb aboard the ship?

It didn't climb aboard, Nemo.

You mean it was captured by humans?!

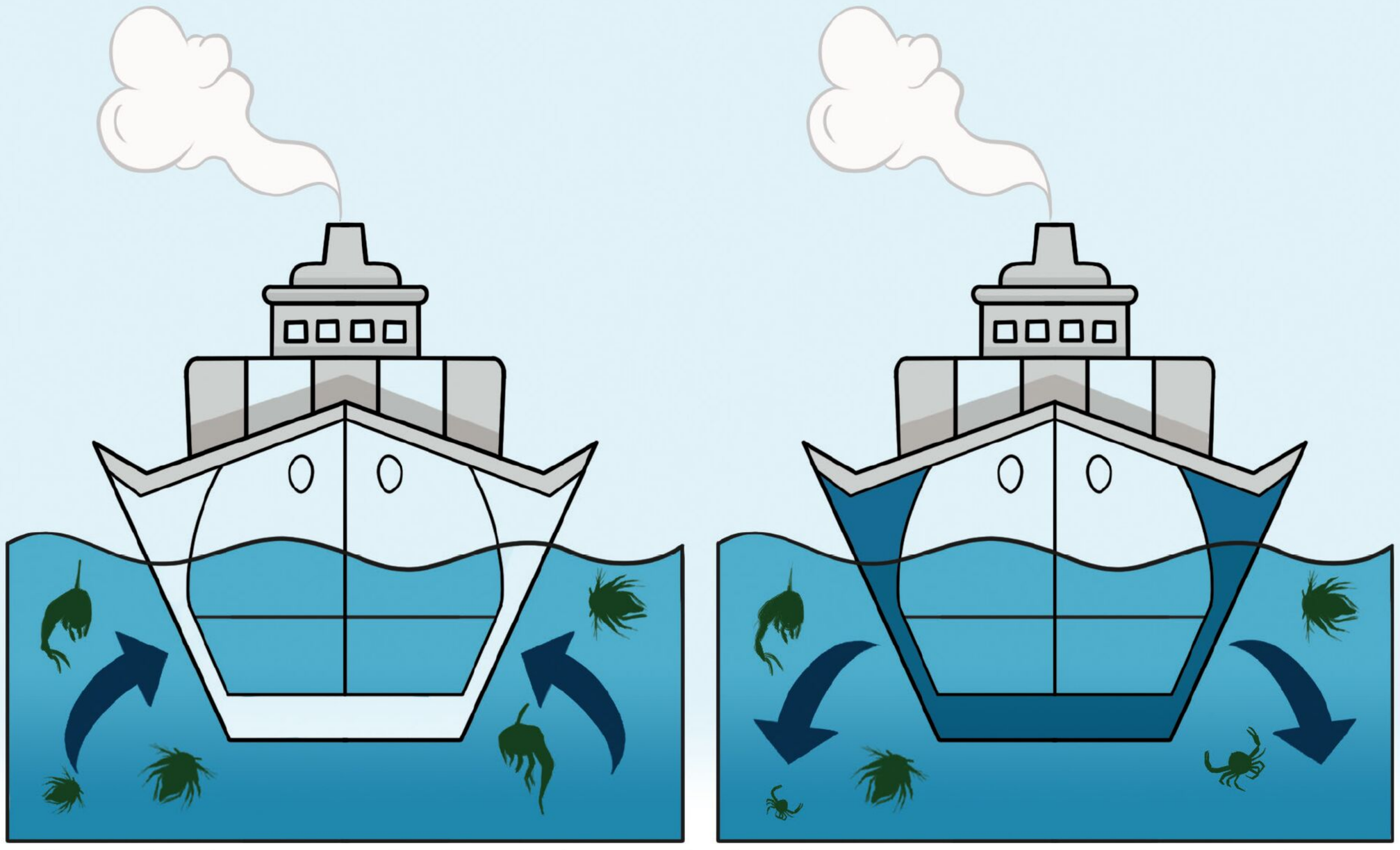
No, Marlin.



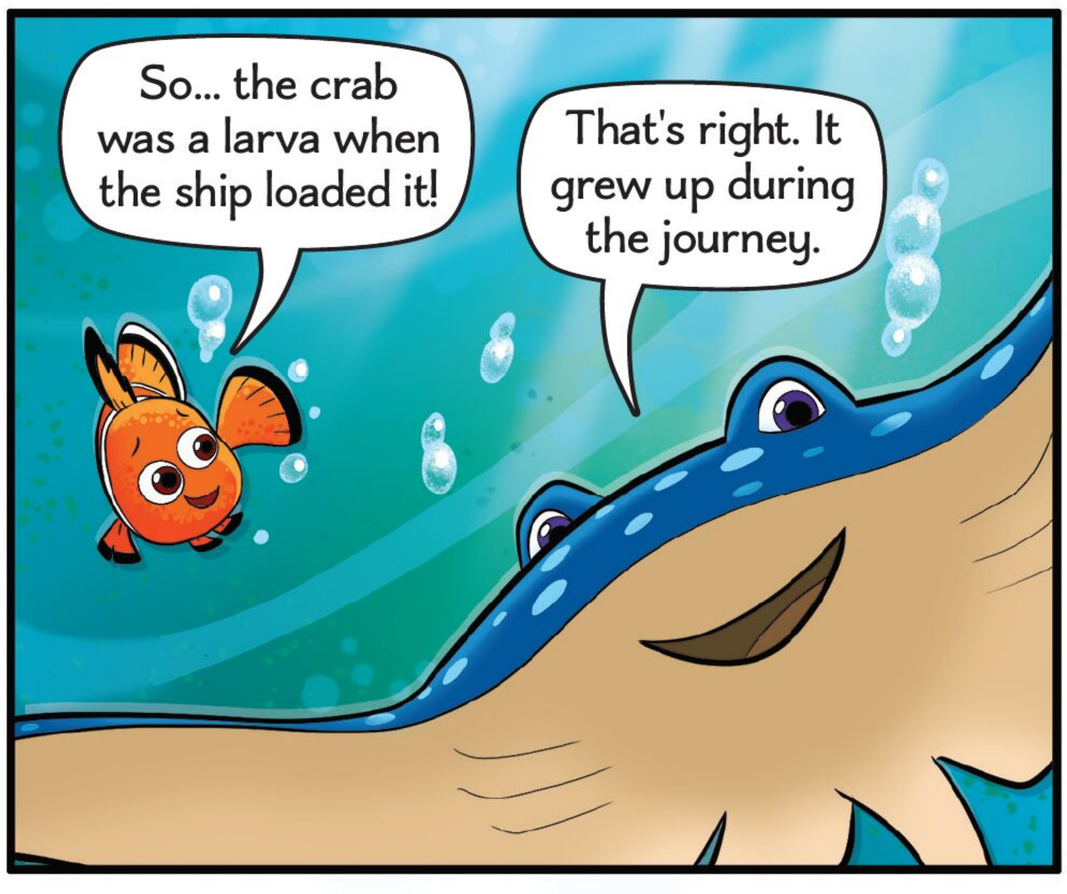
"Before leaving the port, container ships **load water** in their ballast tanks. Well, not just water..."

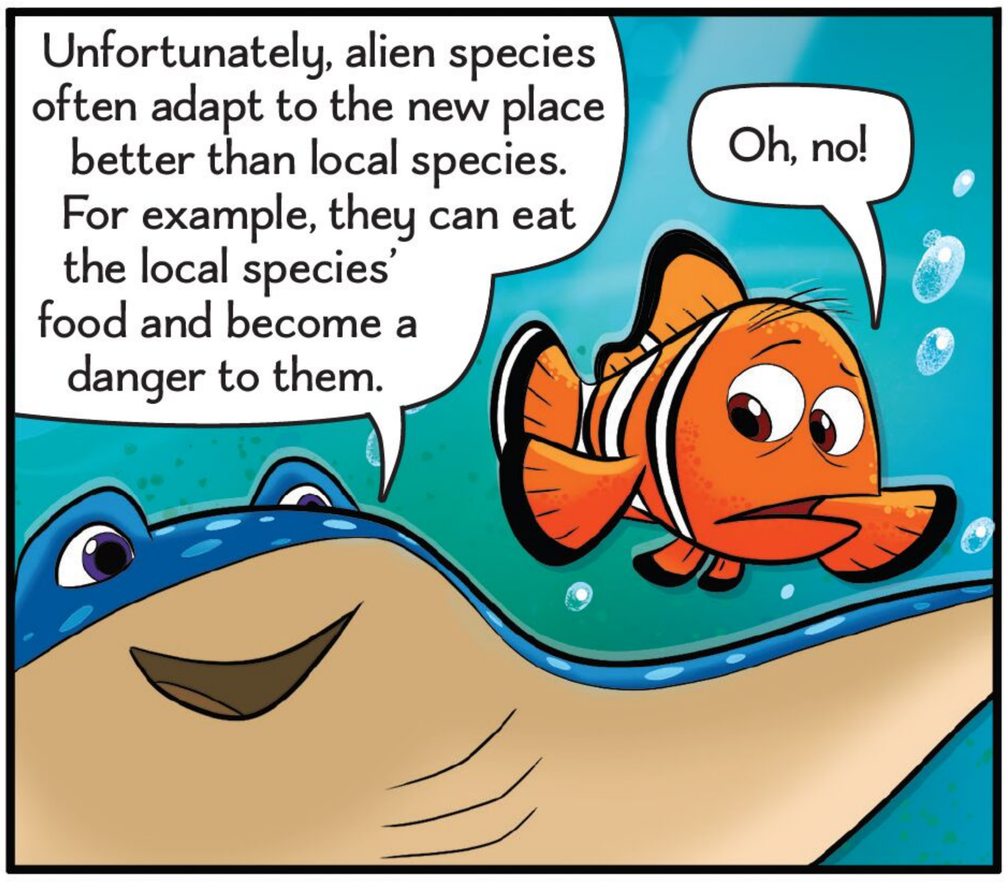
"They also accidentally load some **eggs and larvae*** of marine creatures living in the area and take them all the way **across the sea**."

"When they're close to their destination port, they **empty out the ballast water**, along with their alien 'passengers.'"



Ballast tanks: They are special tanks in the bottom of a ship where water is stored to make the ship heavier and stabilize it at sea.




Unfortunately, alien species often adapt to the new place better than local species. For example, they can eat the local species' food and become a danger to them.
Oh, no!

*Larvae: Organisms in their first stage of development

OUCH!

Hey, this crab isn't very friendly.

PINCH

Let go of my tail!

SWISH

SWOSH

Hee-hee! It wants to come with us.

Ookay... maybe it will let go along the way.

Follow me, guys! My echolocation tells me that the MLI is very close!

Oh, traveling is oh so lyrical... when your group is quite so mythical.

I hope we find the answers we need.

CONTINUES ON PAGE 105

AN OVERFLOWING OCEAN

- What is sea level?
- A growing sea
- Ocean invasions
- Aliens come . . . by boat

What is sea level?

THE SEA RISES

Imagine a line indicating where the sea water reaches the land: that's the **sea level**. So when this line rises, the submerged part of the coast increases, while the dry part is reduced. In the past hundred years, the sea level in the world has risen by about 18 centimeters on average. The rising temperatures cause the planet's glaciers to melt, and the melted ice becomes water, which ends up in the ocean, increasing the total amount of water. So the sea level rises.

This is a metric rod used in the past to measure sea level. Today, the measurements are taken using radar signals sent by satellites.

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A growing sea

SUBMERGED BY WATER

Considering the speed of ongoing climate change, scientists predict that the sea level will rise at least 30 centimeters by the year 2050. And in the following years, by as much as a meter. The water could end up covering the majority of the coasts, forcing their inhabitants to move farther inland. What's more, smaller and flatter islands could disappear entirely. Unfortunately, some small coral islands of the Solomon Islands archipelago, in the Pacific Ocean, have already disappeared.

The populations most threatened by rising sea levels are those living along the coasts, for example on the islands of the Pacific Ocean.

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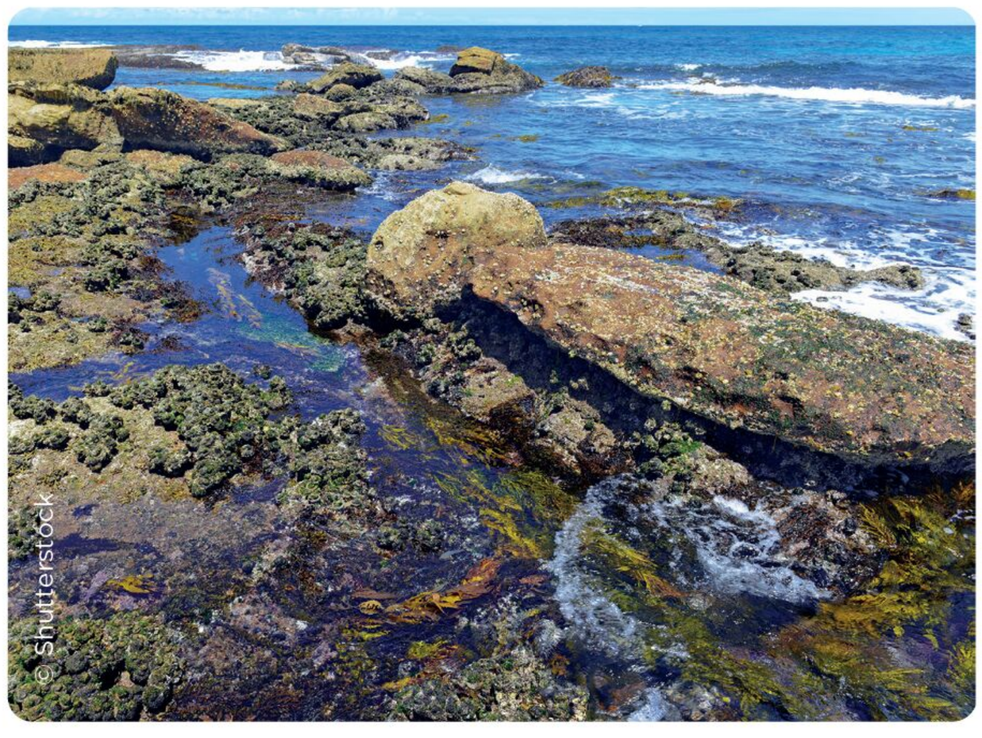
THE TIDES

The water level in a specific place also changes throughout the day due to tides. These cause the level of the sea water to rise, which is called **high tide**, and to lower, at **low tide**, every six hours. However, the total amount of water in the sea doesn't change, since when the tide is high in one place, it's low elsewhere, and vice versa. Tides are very important because they create **intertidal zones** that host special ecosystems. These are parts of the coast that are sometimes covered with water, while at others times they're dry. Such a specific environment forces the species that live there to adapt to the constant change in humidity, temperature, salinity, and movement of the waves.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This is an intertidal ecosystem: a tide pool or an area between the rocks, where the water flows in and out, following the high and low tides.

Ocean invasions

AN . . . ALIEN RISK!

Ocean ecosystems aren't just threatened by climate change but also by other human actions, such as maritime traffic, or the coming and going of boats. These activities can bring **alien species**—species that are not native to that area—into an ecosystem. These may be animals, plants, or microbes that are transported by boats, sometimes very far from their place of origin. When alien species find the right conditions for them to live, such as the right temperature or salinity, they invade the new habitat. Thus, they compete with those species already present in the ecosystem, for example, by eating the available food. The organisms of the alien species therefore become more numerous or more able to hunt than the native ones, whose population may decrease or even disappear. This is how alien species can change the balance in existing ecosystems, thus damaging them.

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The sea walnut is an alien species taken from the Gulf of Mexico to the Mediterranean Sea, the Black Sea, and the Caspian Sea. It's a voracious predator of zooplankton, and fish eggs and larvae.

Aliens come . . . by boat

BALLAST WATER

Often alien species are transported in **ballast water**. This is water that is loaded onto boats, in the departure port, to make them heavier and more stable while sailing. Then, when the ship arrives, the water is thrown back out into the sea, along with everything it contains. That is, the microorganisms, algae, plankton animals, eggs, and larvae loaded on board at the beginning of the journey. This is how many alien species spread around the world. And they can even reach areas that are very far from their places of origin. For example, the *Asterias amurensis* starfish got to Australia from Japan by traveling in ballast water. As one of the hundred most aggressively invasive species in the world, the *Asterias amurensis* has had a damaging effect on the coral reef since arriving in Australia because it eats mollusks, crustaceans, and many other native animals.

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Some countries, such as Australia, have strict rules for ships in order to control and reduce the emptying of ballast water and thus protect their seas.

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Some *Asterias amurensis* larvae arrived in Australia about forty years ago. This starfish feeds on bivalve mollusks and quickly spread to Tasmania.

FINALLY THERE!

Hey, the crab's still clinging to Bailey's tail!

Are we there yet?

Er... yeah... I think so!

What? You mean we might be in the wrong place?

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Oy! Shut it! We're trying to sleep here!

Yeah. We're in the right place!

Hey! I know you two!

Fluke! Rudder! You're still here!

Where else should we be?

Oy! I remember you!

You were on that huge truck!

Yeah... that was so dangerous!

Can you help us get inside the MLI?

Um... don't think so!

There are too many of you this time.

And it's almost lunchtime.

Oh, no! You mean the humans are coming?

Yep. Humans feed every sea lion at the MLI!

They're lucky. Lots of sea lions can't find food where they live.

Why?

I dunno. Our friends out there say the water is really **warm**.

Too warm.

It's a big problem for seaweed, seashells, and rocks and islands, too.

And also for sea lions. They live in many different parts of the world. Some live in the **Galapagos** Islands and some in the subarctic area, but always close to the sea.

Yes, always close to the sea, where we find food!

Anchovies and sardines. Yum!

ASIA

NORTH AMERICA

GALAPAGOS

SOUTH AMERICA

AUSTRALIA

NEW ZEALAND

PACIFIC SARDINE:
Population crashed 90% between 2007 and 2016.

NORTHERN ANCHOVY:
Population has declined 90% since the 1980s.

CALIFORNIA

Yes, but here in California, wild sea lions...

Don't find enough food!

It's because the climate has changed. There aren't as many fish these days as there were in the past!

"And the sea lions from the subarctic regions around the North Pole need ice..."

"To move on and take care of their little babies."

NORTH POLE

Since 1979, more than 20% of the POLAR ICE has melted away.

ARCTIC OCEAN ICE IN 1979

"But the ice is melting because of climate change, and warm water isn't good for their health."

Why is the water warmer?

There are a lot of reasons! One is that sunlight usually reflects off the ice, so the water stays cold.

But if the ice melts, sunlight gets through the water and makes it so much warmer!

Sunlight reflects off the ice

SNOW-AND-ICE-COVERED WATER

HEAT

COLD WATER

Sunlight filters through the water

HEAT

WATER WITHOUT SNOW AND ICE

WARM WATER

Yep, but now you'd better hide!

Lunch is on its way!

I just echolocated it!

WHAAAT?

Whoa! That boat is fast!

Let's hide!

VRRRRRRR

SPLASH

Phew! That was close!

Hey! The crab let go of Bailey's tail.

Finally! Maybe the humans will help it.

I have an idea!

Nemo explains his idea, and everybody agrees.

Good luck, green crab!

Oh, dear! Is that a green shore crab?

It is. Poor thing! This isn't its habitat.

Don't worry, little one. We'll take you home.

SLAP

Yes!

That's my boy! Well done!

Thanks, Dad!

Now it's my turn!

Oh, you guys are hungry today!

SWISH SWISH

Urgh!

Here's your bucket!

Hold on a sec. Isn't it too small for me and Mr. Ray?

No problem, everybody. Bailey and I will wait for you here.

Well, that's a better idea.

And so...

Careful, Nemo!

SPLOSH

VROOOOM

Thanks, Hank!

This is so exciting!

Good luck!

Take care! You're a great team!

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VROOOOM

See you soon!

After a short journey...

Ah, it's good to be back!

I hope everything goes well.

Hey, this is exactly what we need!

Yay! A trolley ride!

Don't go too fast, Hank!

This is the perfect time of day. If I remember right, the humans will be going home soon.

And we can finally look for the answers we need!

OPEN OCEAN

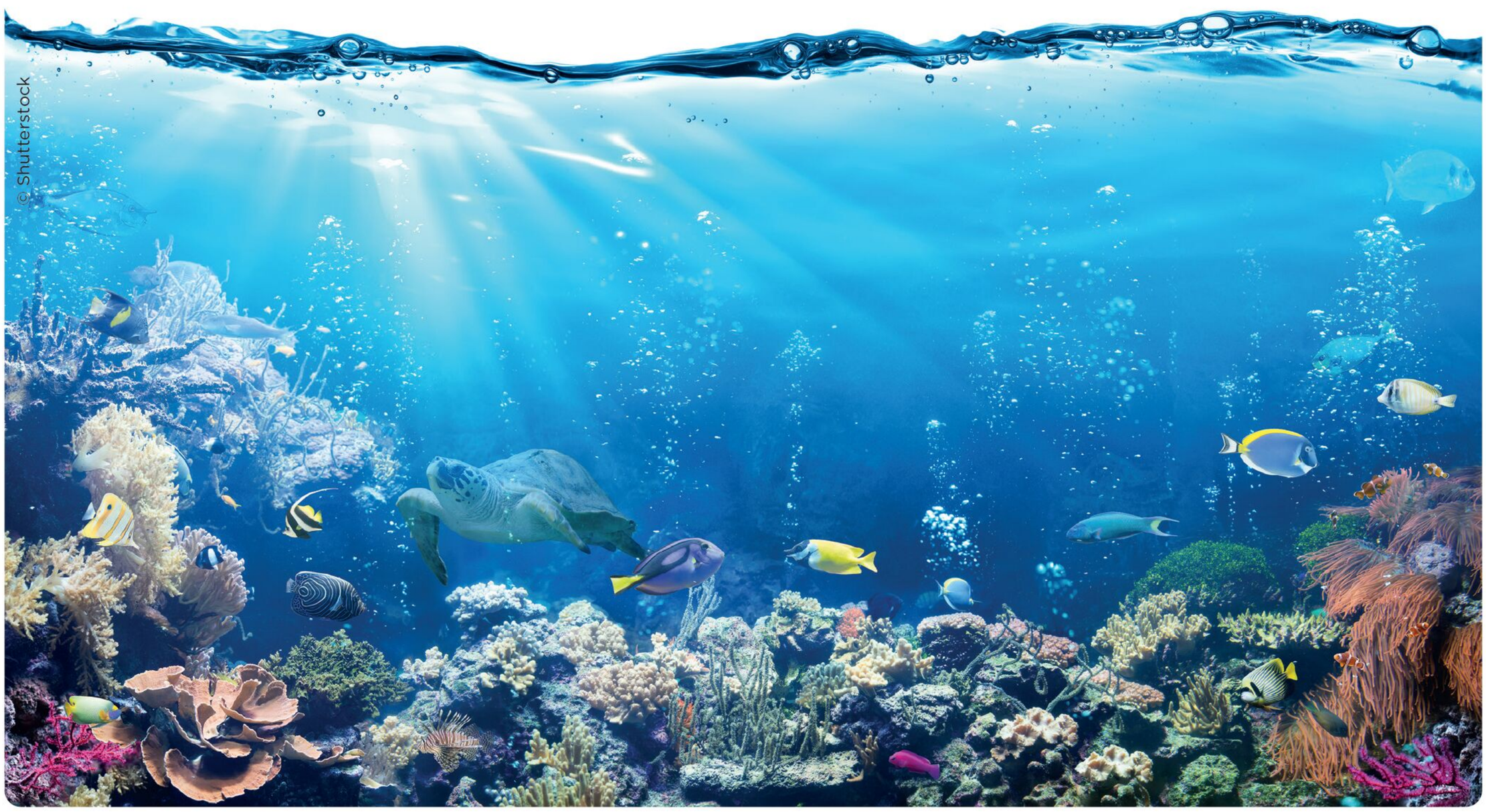
Yay! It's time to save the ocean!

CONTINUES ON PAGE 119

THE EFFECTS OF CLIMATE

- A few changes, a lot of damage
- The climate affects everyone!
- Sea lions

A few changes, a lot of damage



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Coral reefs are the richest living marine habitats. And they're very sensitive to changes in the climate.

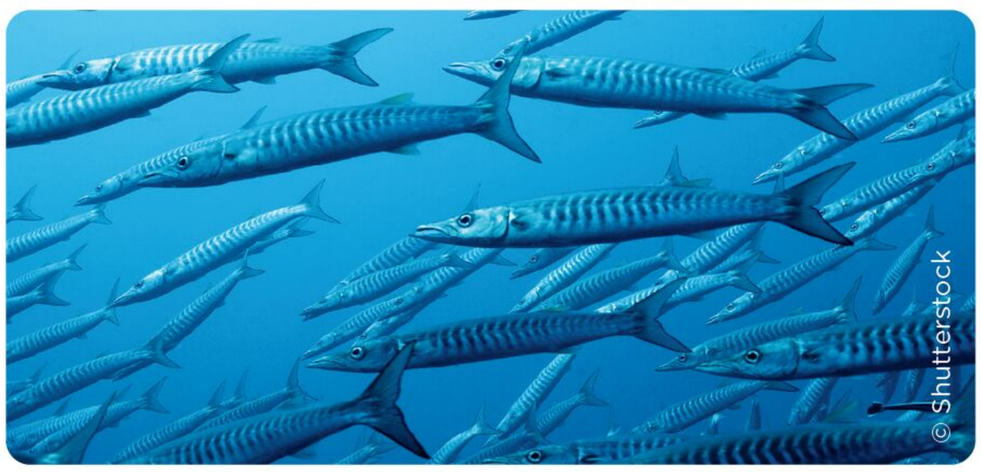
IMPACTING THE HABITATS

There are many different habitats in the ocean. And their differences depend above all on light, depth, and some characteristics of the water: its temperature, the amount of salt and oxygen it contains, and its pH. All these elements are **connected**, so if one changes, all the others change too, and that negatively affects the habitats, posing a threat to their existence. For example, it has been observed that the increase in temperature endangers plankton, which is at the bottom of the food chain in every ecosystem, and that has an impact on a large scale.

The climate affects everyone!

ADAPT OR DISAPPEAR

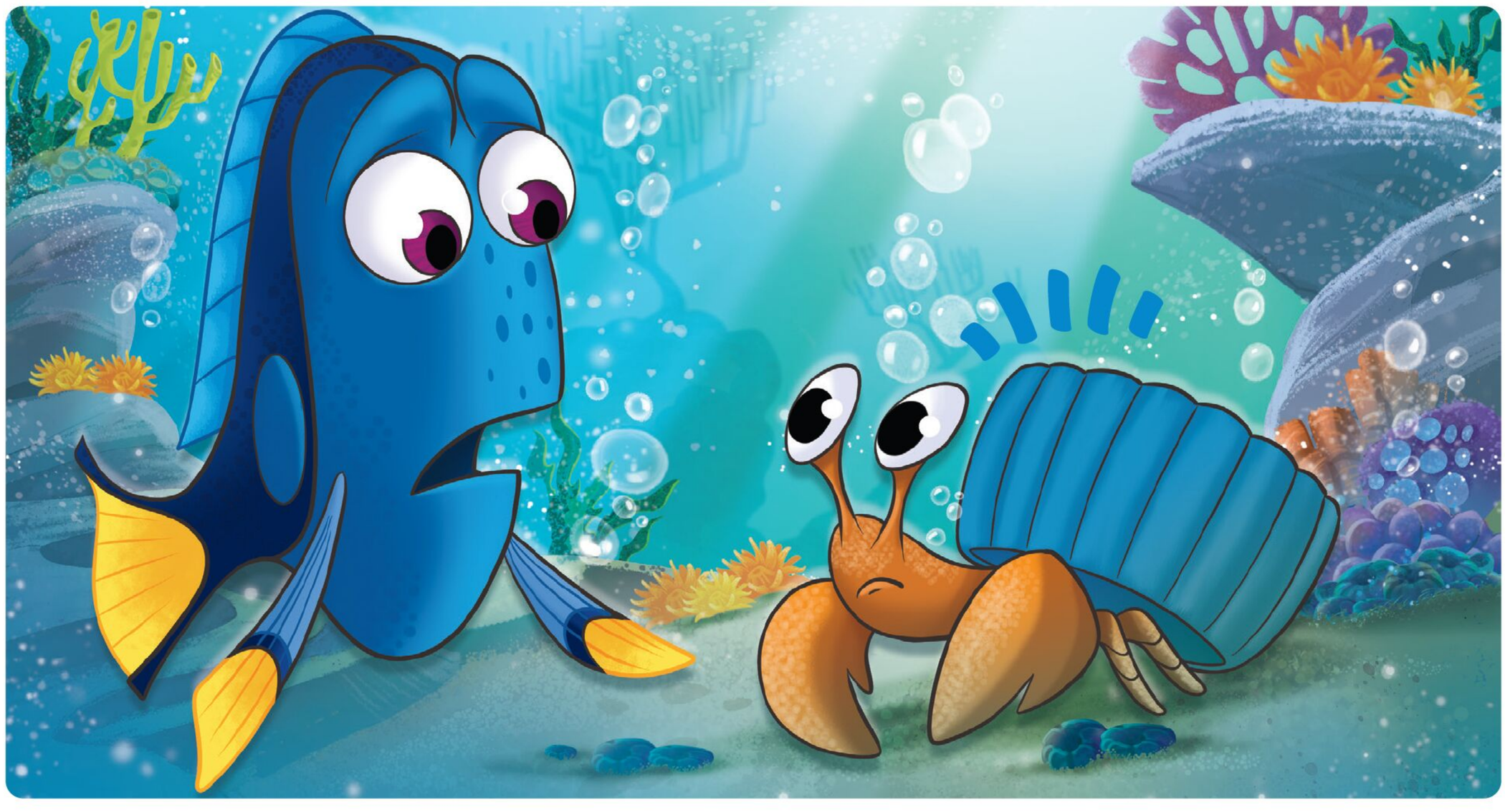
When habitats change, some marine organisms adapt, while others can't survive variations. For example, some Antarctic fish have a substance in their blood that prevents them from freezing. But they can't survive in warmer waters, so if the temperature increases, they risk becoming extinct. On the other hand, some animals migrate to new habitats that become suitable for them due to climate change. For example, with the rising temperatures, the northern Mediterranean waters have warmed up enough that some species typical of warmer climates have moved to live in that area. In all these cases, the **delicate balance** of the ecosystems has been altered.



Barracudas are native to the southern Mediterranean, such as the sea around Morocco and Tunisia. Today, they're also found off the coast of France and Northern Italy.

RISKS FOR HUMANS, TOO

Damage to marine ecosystems **is also a problem for human activities**. For example, the reduction of sea meadows increases damage to the coasts, where humans live, by erosion caused by the force of the waves. What's more, tourism is declining due to the diminishing biodiversity in coral reefs, and this in turn reduces an important source of income for many countries. Plus, damage to natural habitats means fewer fish in the ocean, which are



part of the human diet. So in order to get enough fish, humans increase fishing actions and also catch small specimens that haven't had time to reproduce yet. This reduces the number of fish even more!

However, the creation of **Marine Protected Areas** helps defend the biodiversity of the ocean, because fishing and other activities are forbidden or strictly regulated in these areas so marine creatures have a safe place to live and reproduce.

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A dead fish that swallowed plastic. Human pollution is one of the causes of the diminishing number of fish in the ocean.

Sea lions

ANIMALS TO SAVE!

Sea lions are among the **most endangered** marine animals. They're curious and sociable mammals and let humans approach them. They are intelligent and able to learn from their experiences. They can even recognize musical rhythms!

Sea lions mostly live in North America, Australia, New Zealand, and the Galapagos Islands. Unfortunately,

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In the polar regions, ice is essential for sea lions. It's where they rest and reproduce, keeping their pups safely out of the water until they learn to swim.

© Science Photo Library

Sea lions are also at risk of dying due to human activities like fishing. For example, they may get tangled up in fishing nets.

they have been an endangered species for a long time. In the past, they were hunted for their skins and fat. What's more, sea lions suffer greatly from the effects of climate change. For example, in Alaska, rising temperatures melt the ice sheets on which they live and rest, so their pups are forced to dive into the water even before they've learned to swim well. And it's difficult for them to survive.

BEWARE OF THE ALGAE!

Recently, climate change has brought about a new threat to sea lions. The rising temperatures in some regions, such as California, have caused large-scale spreading of **a marine plankton diatom**. These are small algae that contain a substance that's toxic to sea lions' nervous systems. The diatoms are eaten by mollusks, which are then eaten by fish. And finally, in turn, sea lions feed on the fish. So the more diatoms there are in the sea, the more they are eaten by all the animals along the food chain, right up to sea lions—along with the toxin they contain. In this way, without realizing it, sea lions swallow large quantities of toxin every day, damaging their nervous systems.

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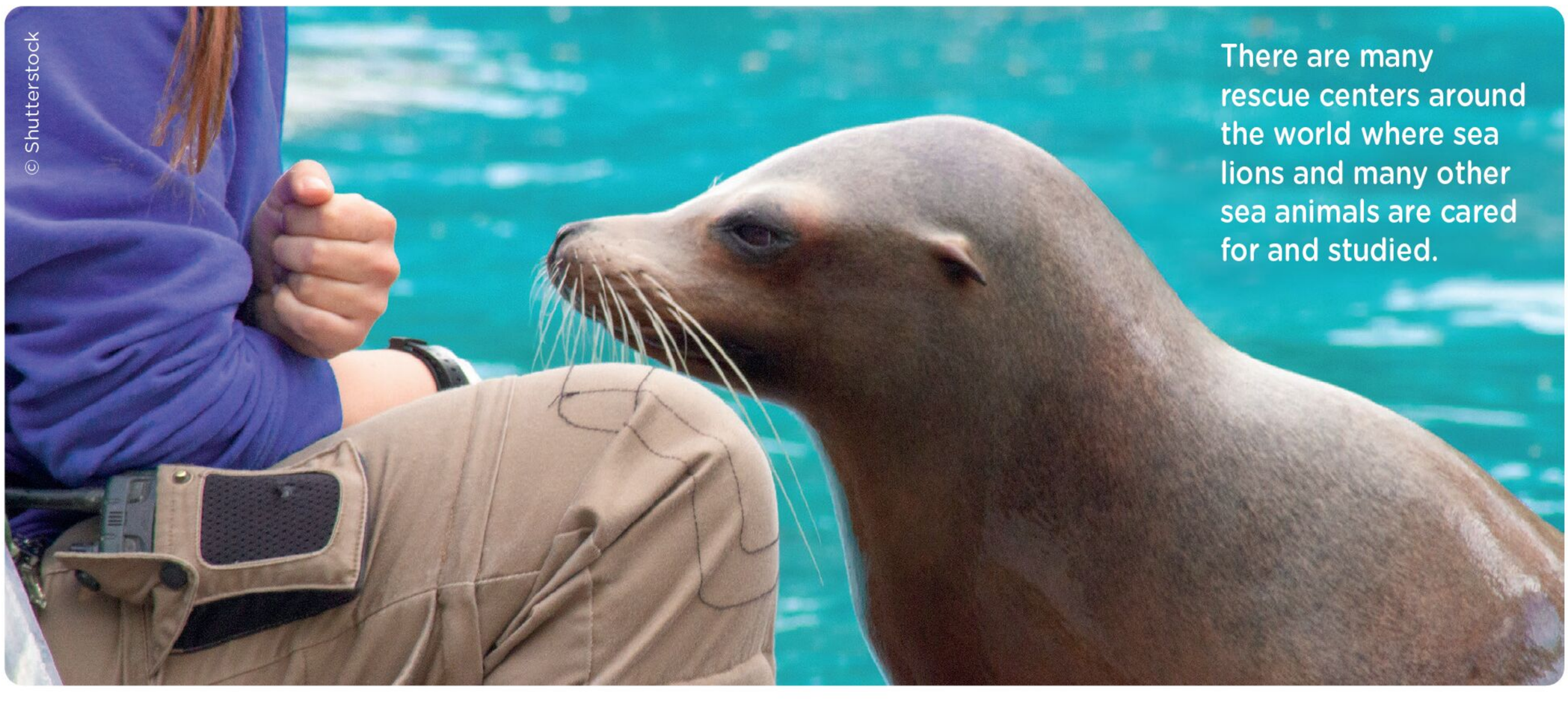
Diatoms of the *Pseudo-nitzschia* genus produce domoic acid, which causes sea lions to suffer convulsions and become disoriented.

WHAT CAN BE DONE?

Sea lions are in real danger. To help them, humans need to respect their habitats by limiting climate change, for example, by **reducing the CO_2 emissions** caused by human activities. To achieve this, use of private cars should be reduced in favor of bicycles or public transport. It's also important that humans don't disturb sea lions in their environment: they shouldn't get too close or scare them. And any sea lions in distress, breathing with difficulty, or looking unwell, should be reported to the coast guard. Every citizen has a part to play in protecting them, also by promoting and being aware of the work of those involved in the welfare of these animals, such as scientists, research institutes, and environmental organizations.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There are many rescue centers around the world where sea lions and many other sea animals are cared for and studied.